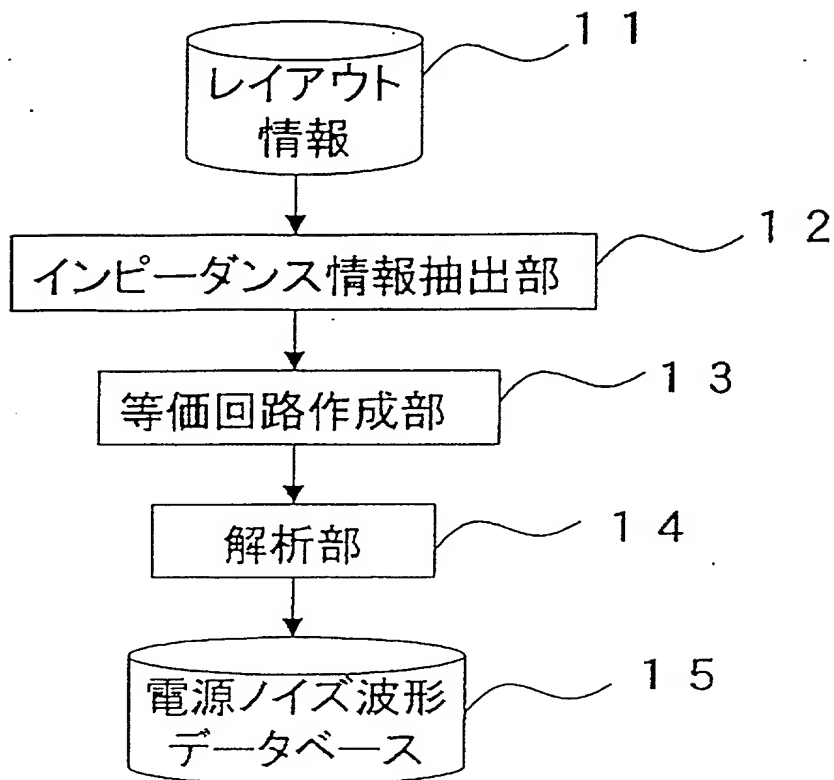


【書類名】 図面

【図1】 Fig. 1.

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11: Layout information

12: Impedance information extracting section

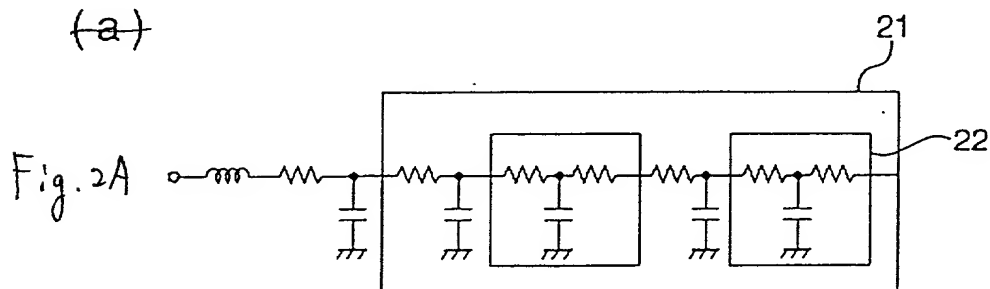
13: Equivalent circuit creating section

14: Analysis section

15: Power noise waveform database

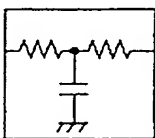
【図2】

(a)



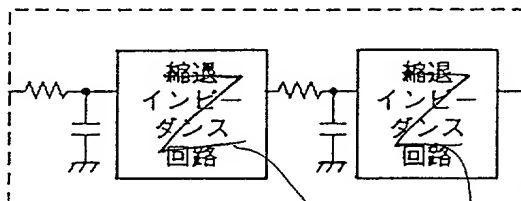
(b)

Fig. 2B



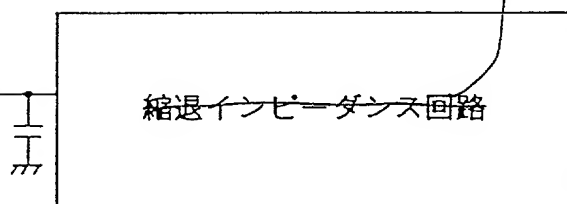
(c)

Fig. 2C



(d)

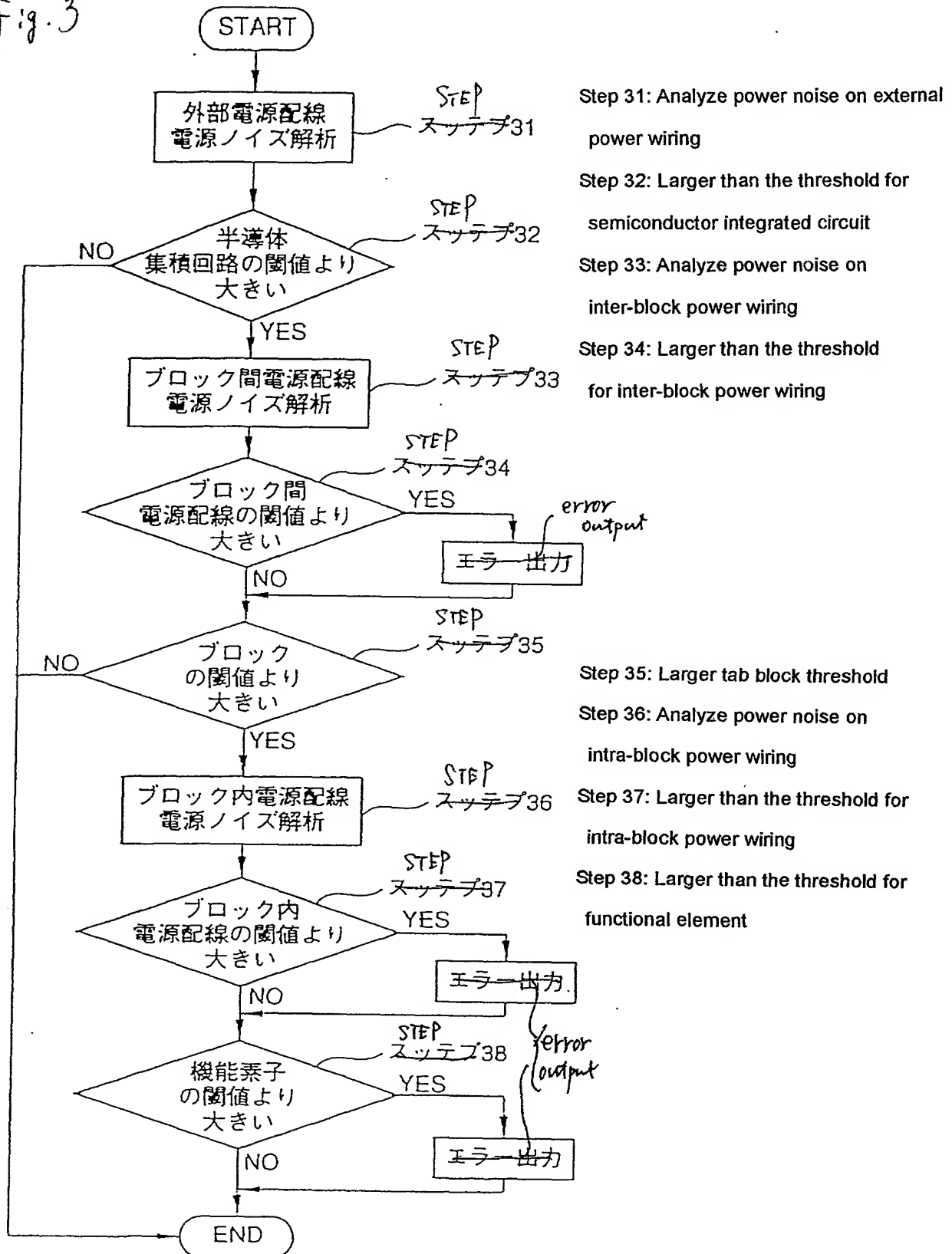
Fig. 2D



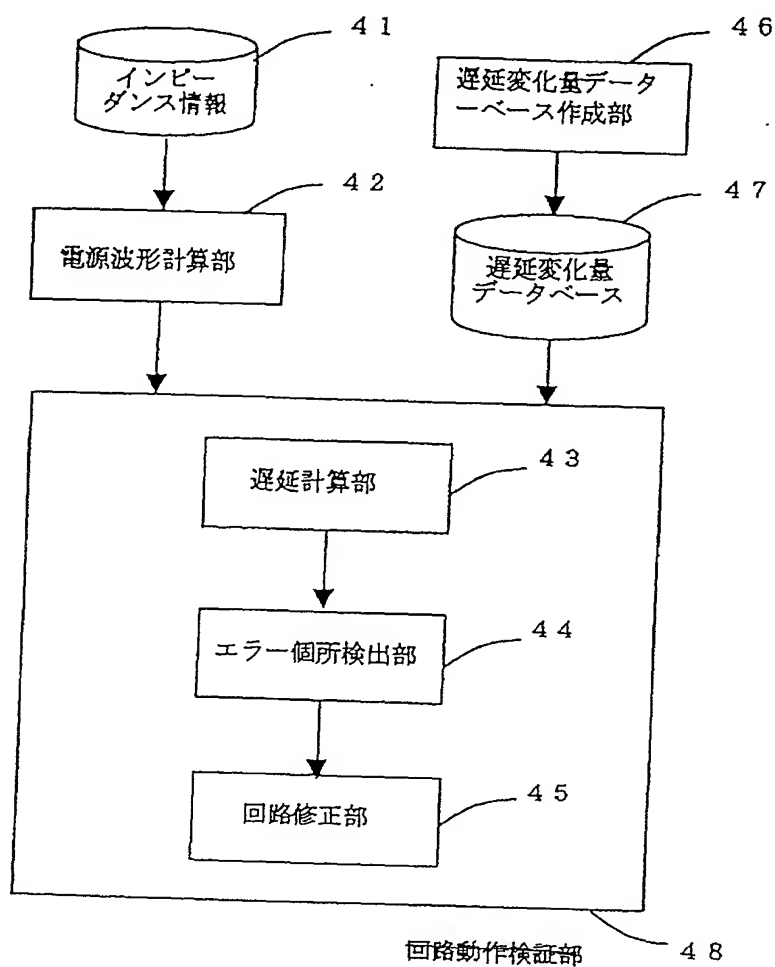
degenerate  
impedance  
circuit

【図3】

Fig. 3



【図4】 Fig. 4



41: Impedance information

42: power waveform calculating section

43: Delay calculation section

44: Error section detector

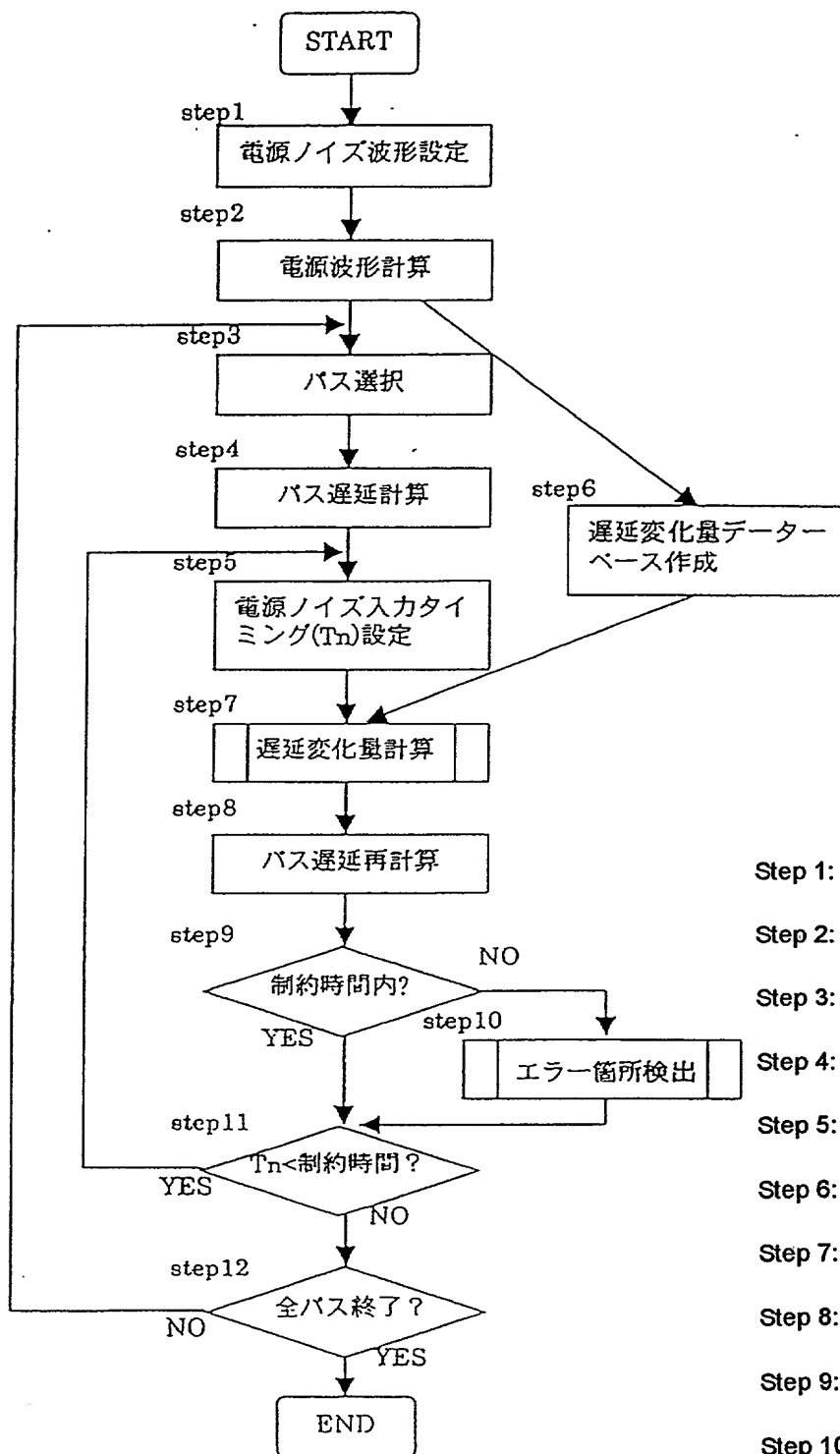
45: Circuit modification section

46: Delay variation amount database creating section

47: Delay time variation amount database

48: Circuit operation verification section

【図5】 Fig.5



Step 1: Set power noise waveform.

Step 2: Calculate power waveform.

Step 3: Select path.

Step 4: Calculate path delay.

Step 5: Set power noise input timing(Tn).

Step 6: Create delay variation amount databas

Step 7: Calculate delay variation amount.

Step 8: Re-calculate path delay.

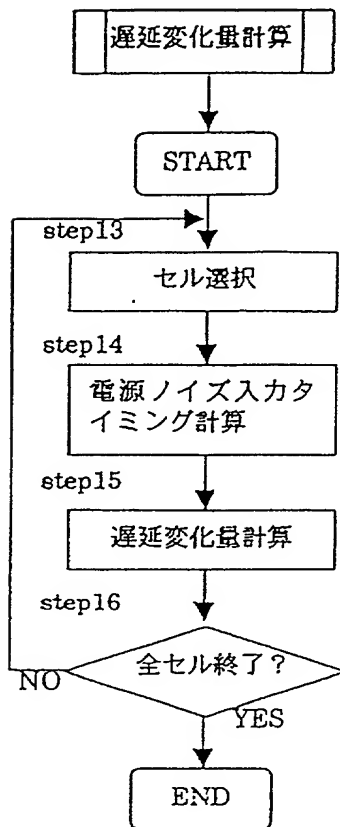
Step 9: Within constraint time?

Step 10: Error section detected

Step 11: Tn<constraint time?

Step 12: Complete for all paths?

【図6】 Fig. 6



Calculate delay variation amount.

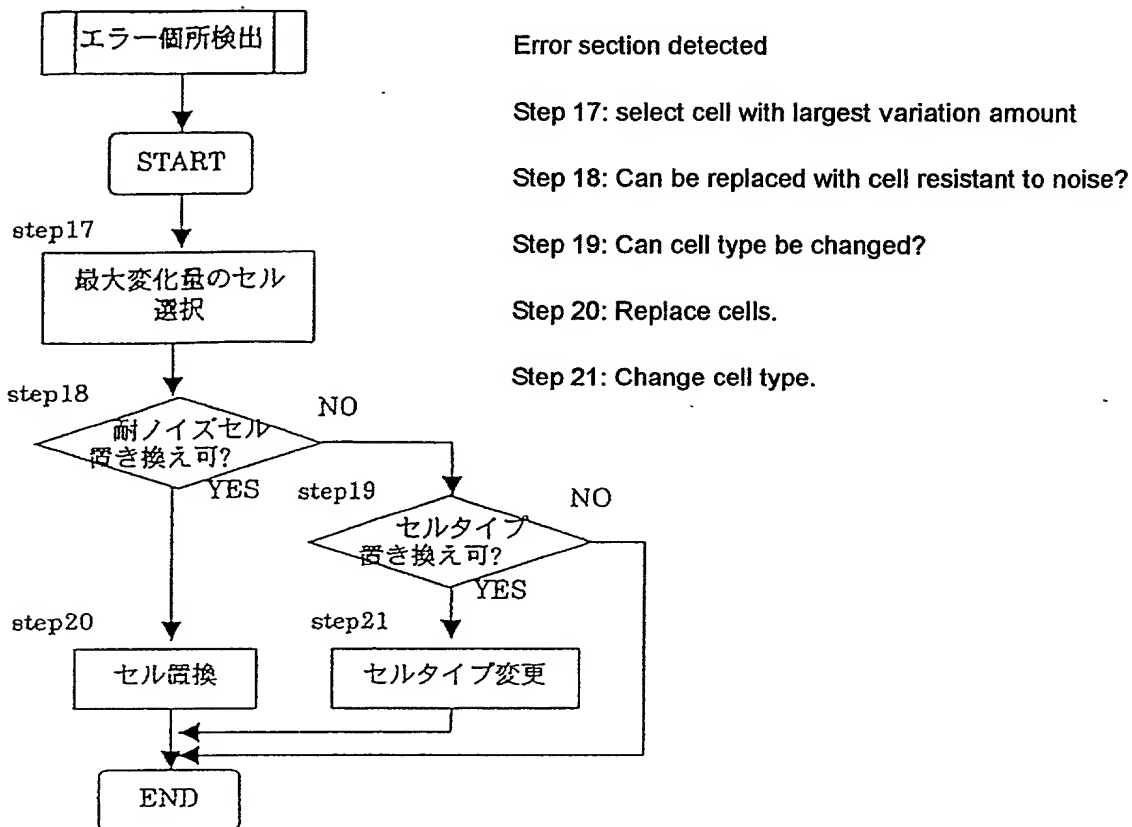
Step 13: Select cell.

Step 14: Calculate power noise input timing.

Step 15: Calculate delay variation amount.

Step 16: Complete for all paths?

【図7】 Fig. 7



【図8】 Fig. 8

セル名	ピーク値	電源ノイズ入力タイミング毎の遅延変化量				
		-20	-10	0	+10	+20
NAND1	10	0	-3	-5	-3	0
NAND1	5	0	-1	-3	-1	0
NAND1	-5	0	+1	+3	+1	0
NAND1	-10	0	+3	+5	+3	0
"	"	"				

Cell name

Peak value

Delay variation amount per power noise input timing

【図9】

(a)電磁放射(radiation)による直接EMS

Fig. 9A

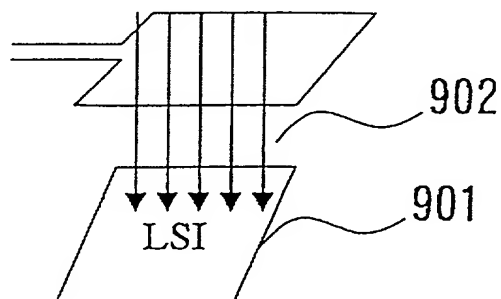
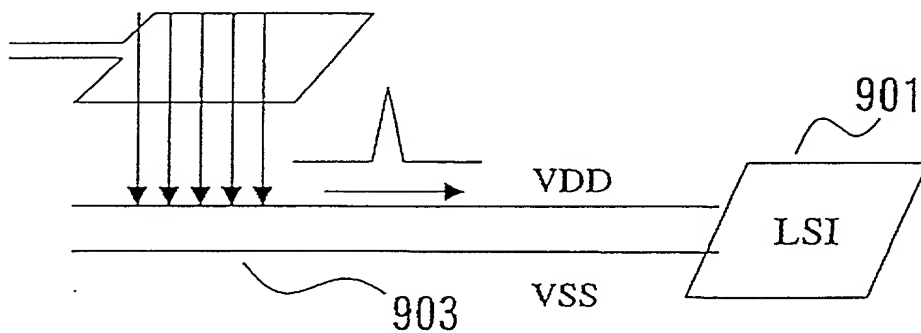


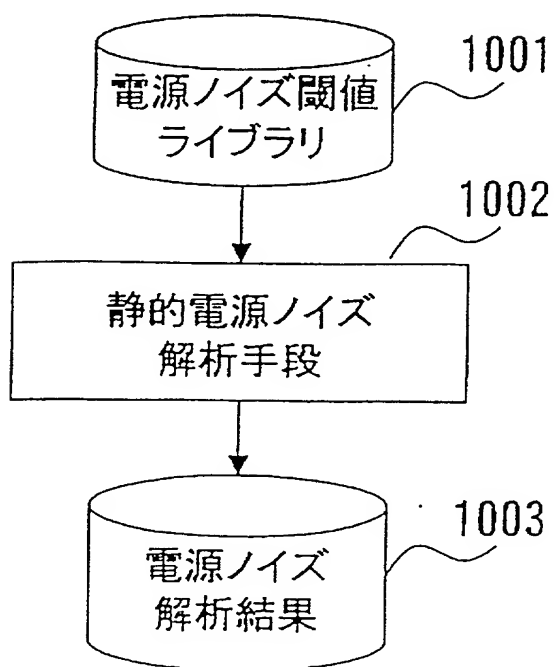
Fig. 9B

(b)電源からの間接EMS





〔図10〕 Fig.10



1001: Power noise threshold library

1002: Static power noise analysis means

1003: Power noise analysis result

【図11】

Fig. 11A

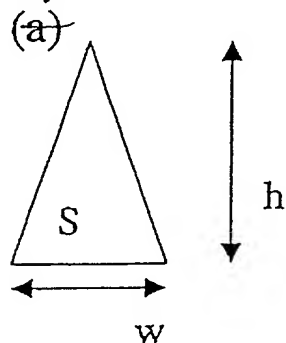
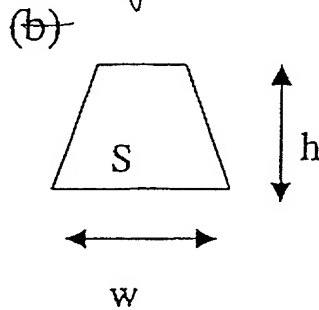
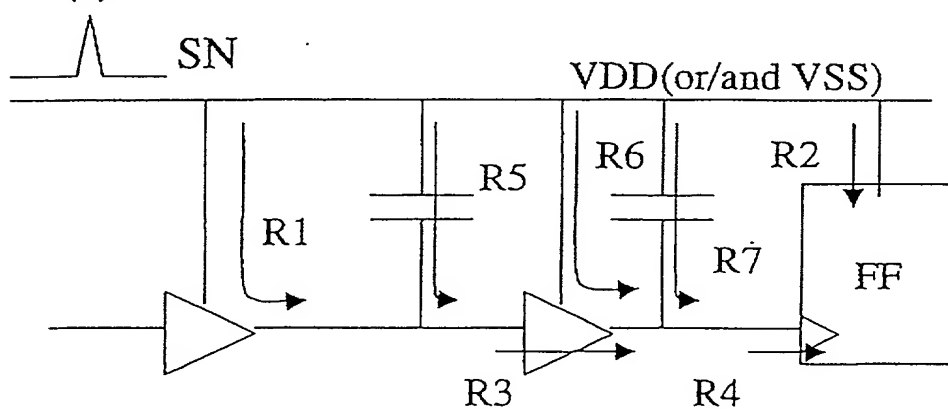


Fig. 11B

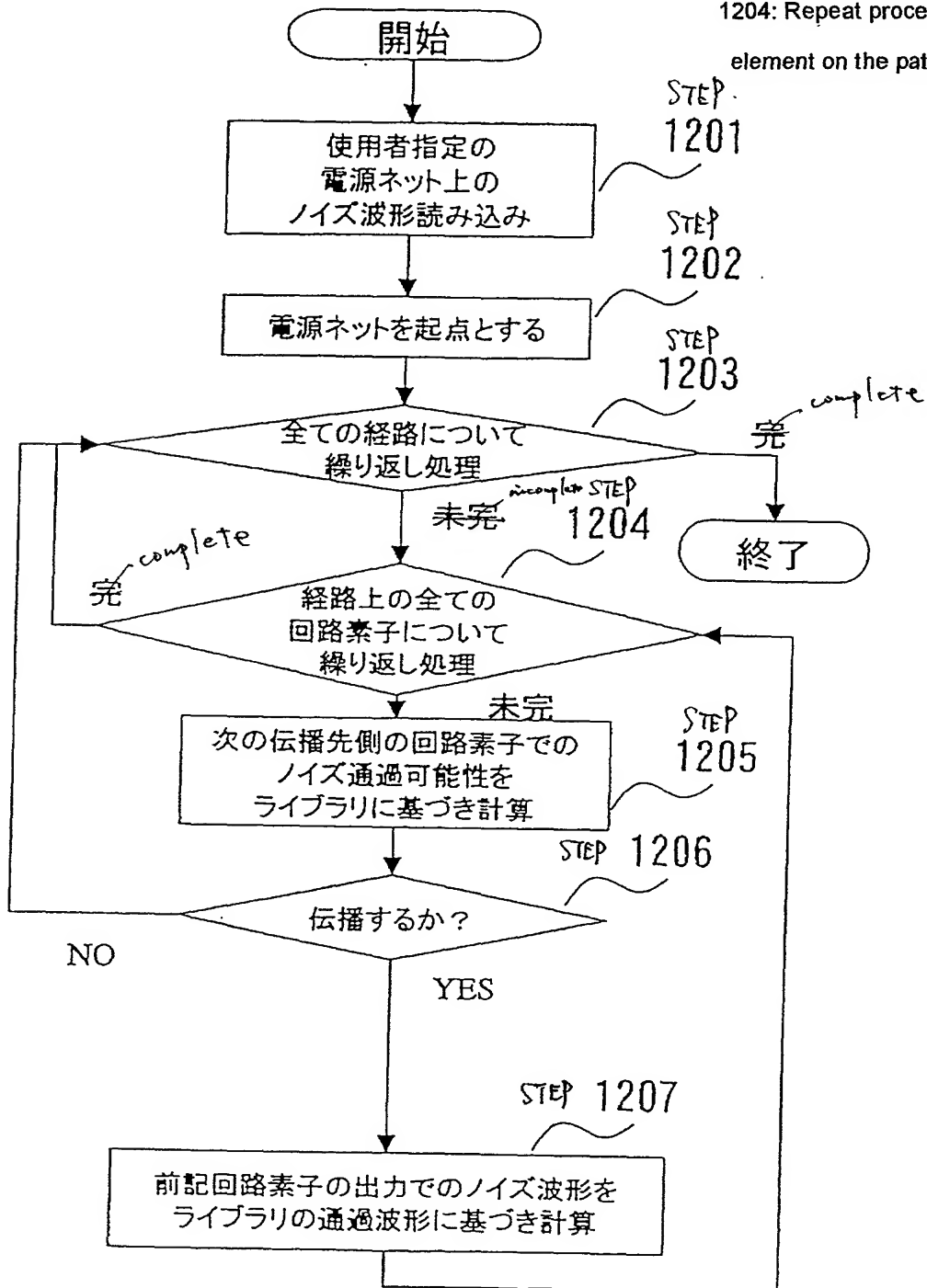


(c) Fig. 11C



整理番号=5037530004

【図12】 Fig. 12



1205: Calculate the possibility of noise passing through the circuit element at the next propagation destination

1206: Propagated?

1207: Calculate the noise waveform at the output of the circuit element based on the passage waveform in the library

Start

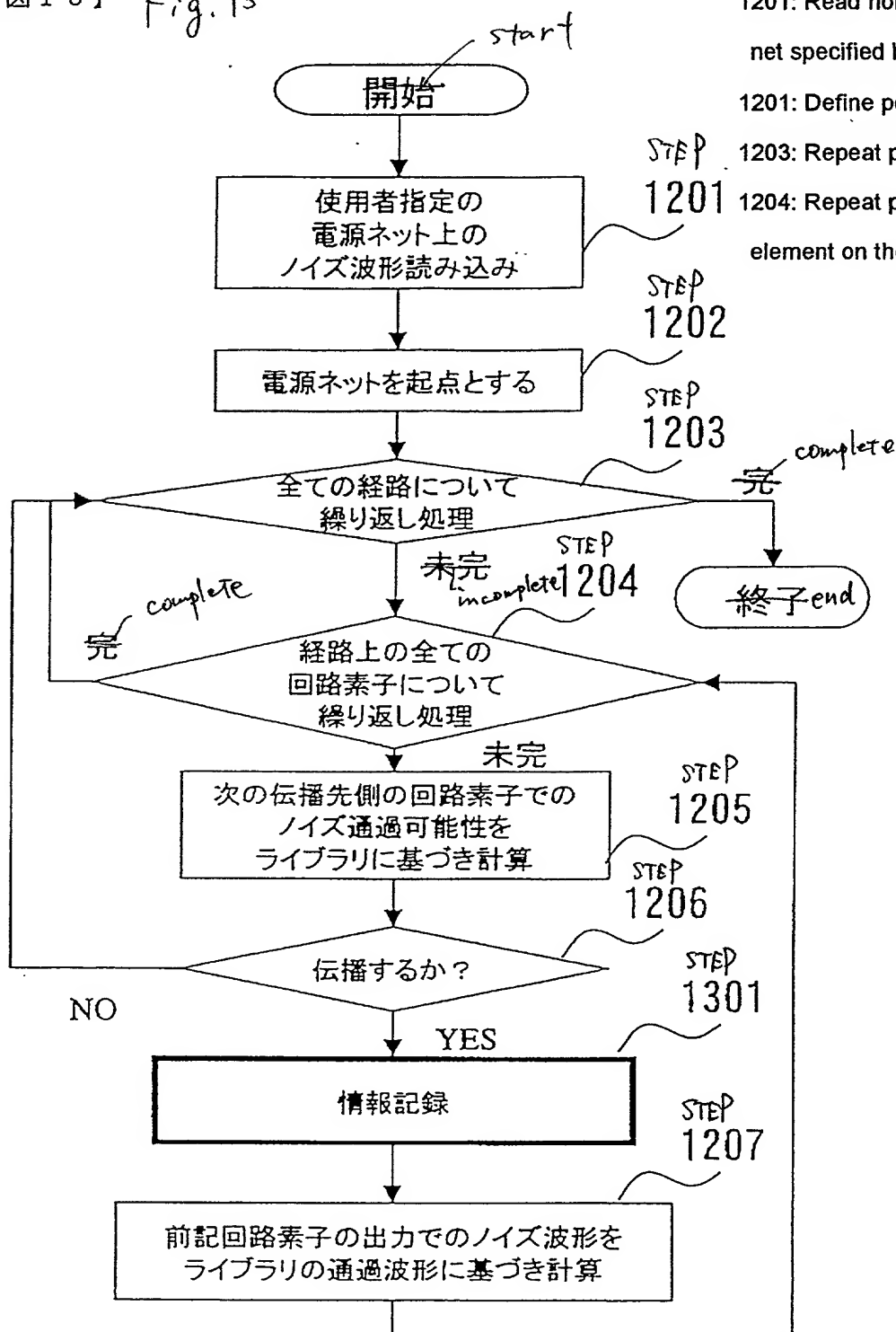
提 1201: Read noise waveform on the power net specified by the user

1202: Define power net as a start point

1203: Repeat processing for all paths

1204: Repeat processing for all circuit element on the path

【図13】 Fig. 13



1201: Read noise waveform on the power net specified by the user

1201: Define power net as a start point

1203: Repeat processing for all paths

1204: Repeat processing for all circuit element on the path

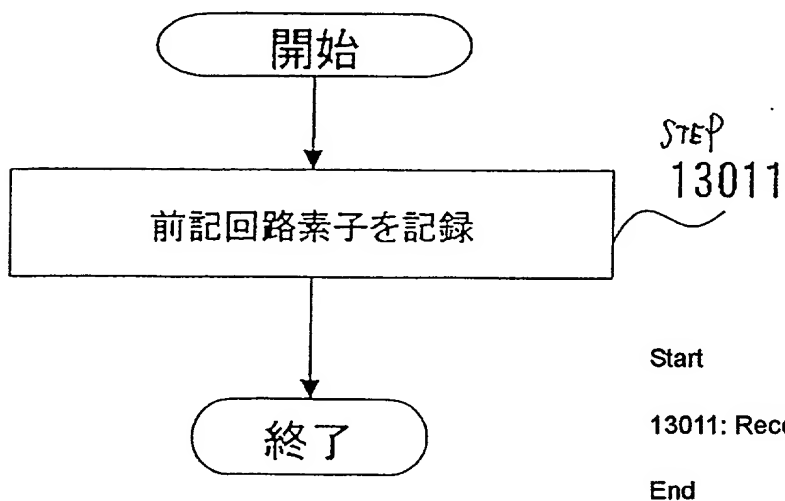
1205: Calculate the possibility of noise passing through the circuit element at the next propagation destination

1206: Propagated?

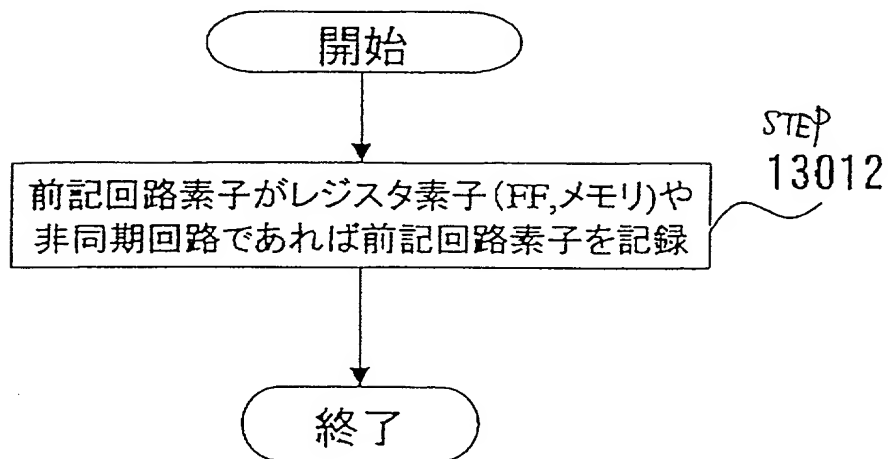
1301: Record information.

1207: Calculate the noise waveform at the output of the circuit element based on the passage waveform in the library

~~【図14】~~ Fig. 14



~~【図15】~~ Fig. 15

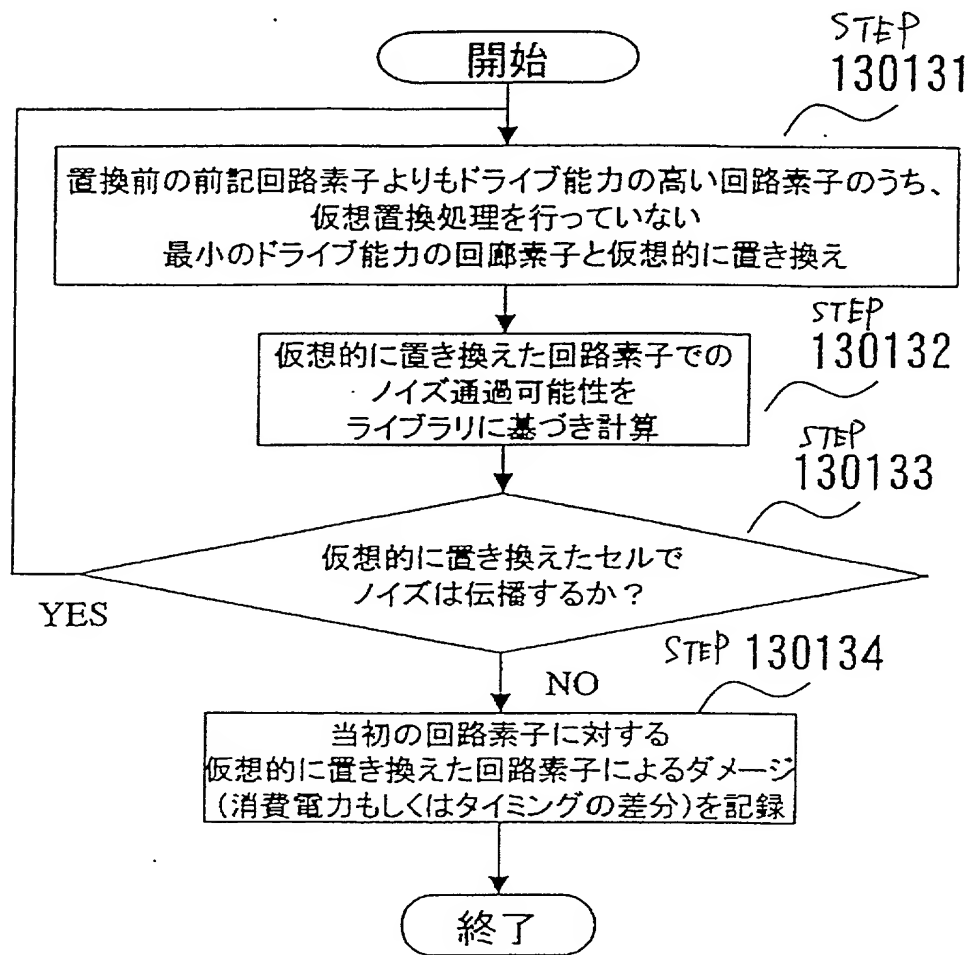


Start

13011: Record the circuit element in case the circuit element is a register element (FF, memory) or asynchronous circuit.

End

【図16】 Fig. 16



Start

130131: Virtually replace with a circuit element with the smallest drive capability not yet virtually replaced among the circuit elements with higher drive capability than the circuit element to be replaced.

130132: Calculate the possibility of noise passing through the new circuit element based on the library.

130133: Is a noise propagated in the new cell virtually replaced?

130134: Record a damage of the new circuit element virtually replaced on the original circuit element (difference of power consumption or timing).

End

1201: Read noise waveform on the power net specified by the user

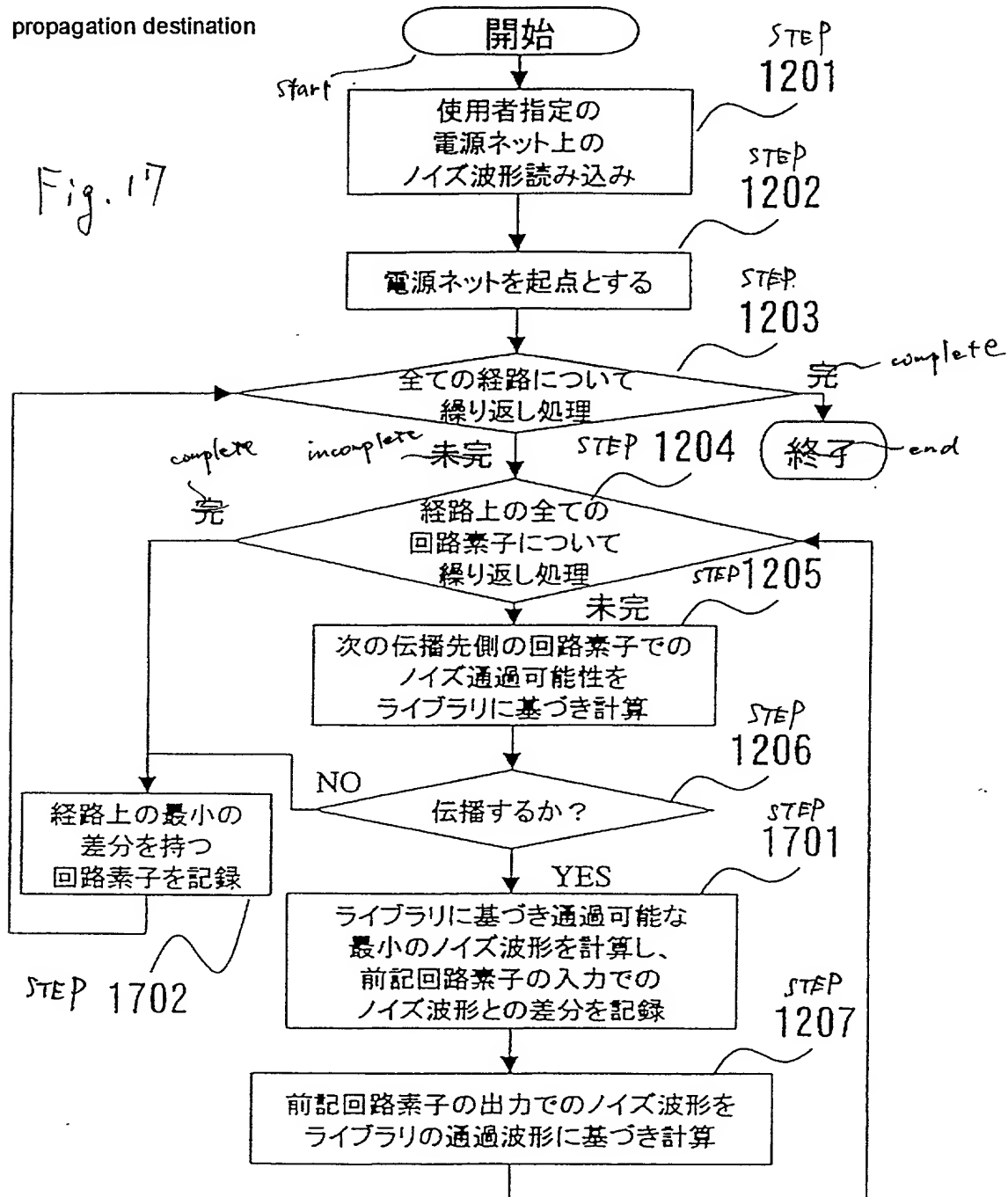
1201: Define power net as a start point

1203: Repeat processing for all paths

1204: Repeat processing for all circuit element on the path

1205: Calculate the possibility of noise passing through the circuit element at the next propagation destination

8日  
/ 32



1206: Propagated?

1701: Calculate the smallest noise waveform that can pass based on the library and record the difference from the noise waveform at the input of the circuit element

1702: Record the circuit element with the smallest difference on the path

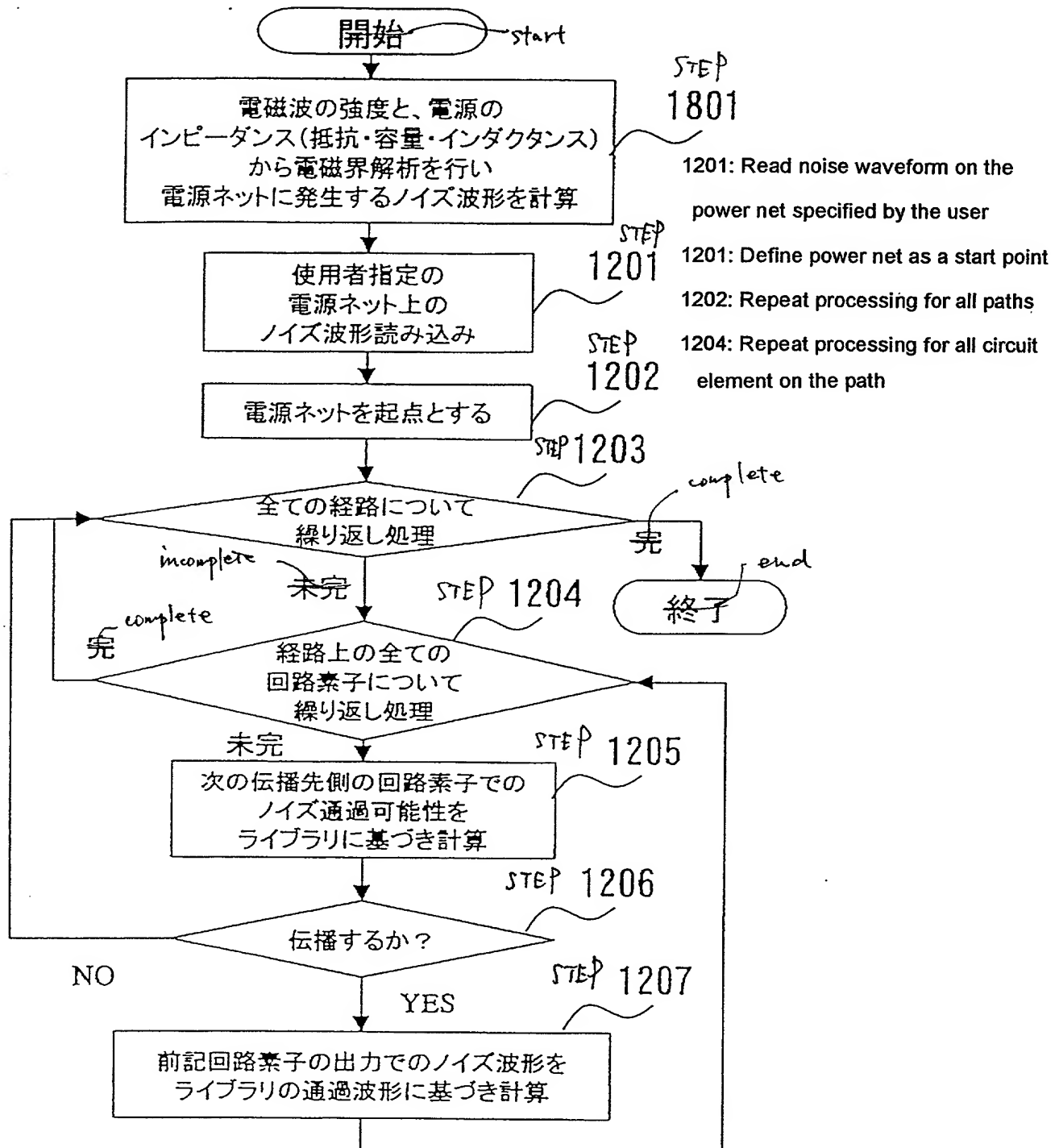
1207: Calculate the noise waveform at the output of the circuit element based on the passage waveform in the library

1801: Analyze electromagnetic field from the intensity of the electromagnetic wave and impedance (resistance, capacitance, inductance) of the power source and calculate a noise

整理 waveform that occurs on the power net

8日  
32

【図18】 Fig.18



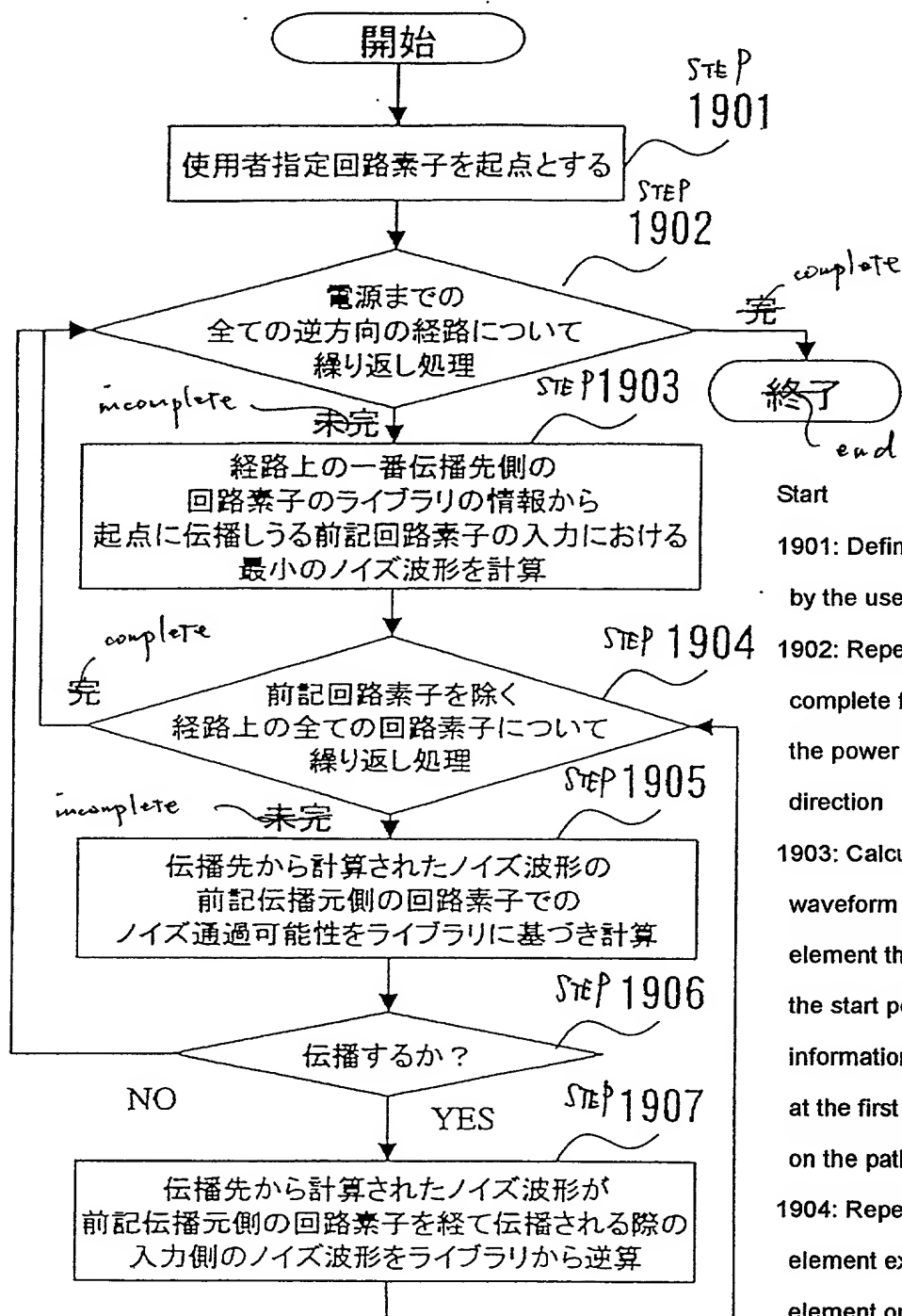
1205: Calculate the possibility of noise passing through the circuit element at the next propagation destination

1206: Propagated?

1207: Calculate the noise waveform at the output of the circuit element based on the passage waveform in the library



【図19】 Fig.19



Start

1901: Define circuit element specified by the user as a start point

1902: Repeat procedure until it is complete for all the paths up to the power source in the opposite direction

1903: Calculate the minimum noise waveform at the input of the circuit element that can be propagated to the start point based on the library information on the circuit element at the first propagation destination on the path

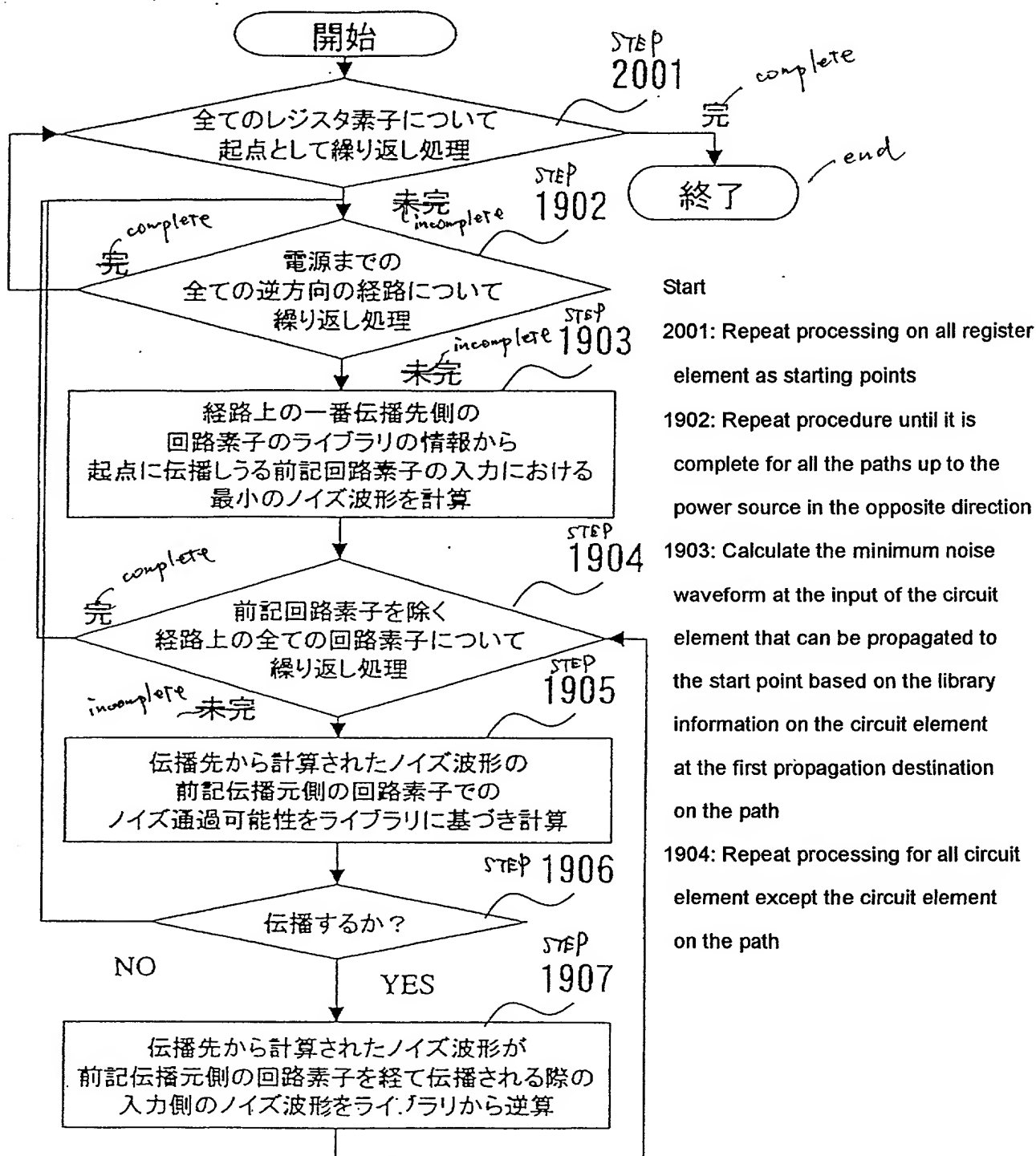
1904: Repeat processing for all circuit element except the circuit element on the path

1905: Calculate the possibility of noise waveform calculated from the propagation destination passing through the circuit element at the propagation source based on the library

1906: Propagated?

1907: Calculate the noise waveform at the input assumed when the noise waveform calculated from the propagation destination is propagated through the circuit element at the propagation source based on the library

【図2-0】 Fig. 20



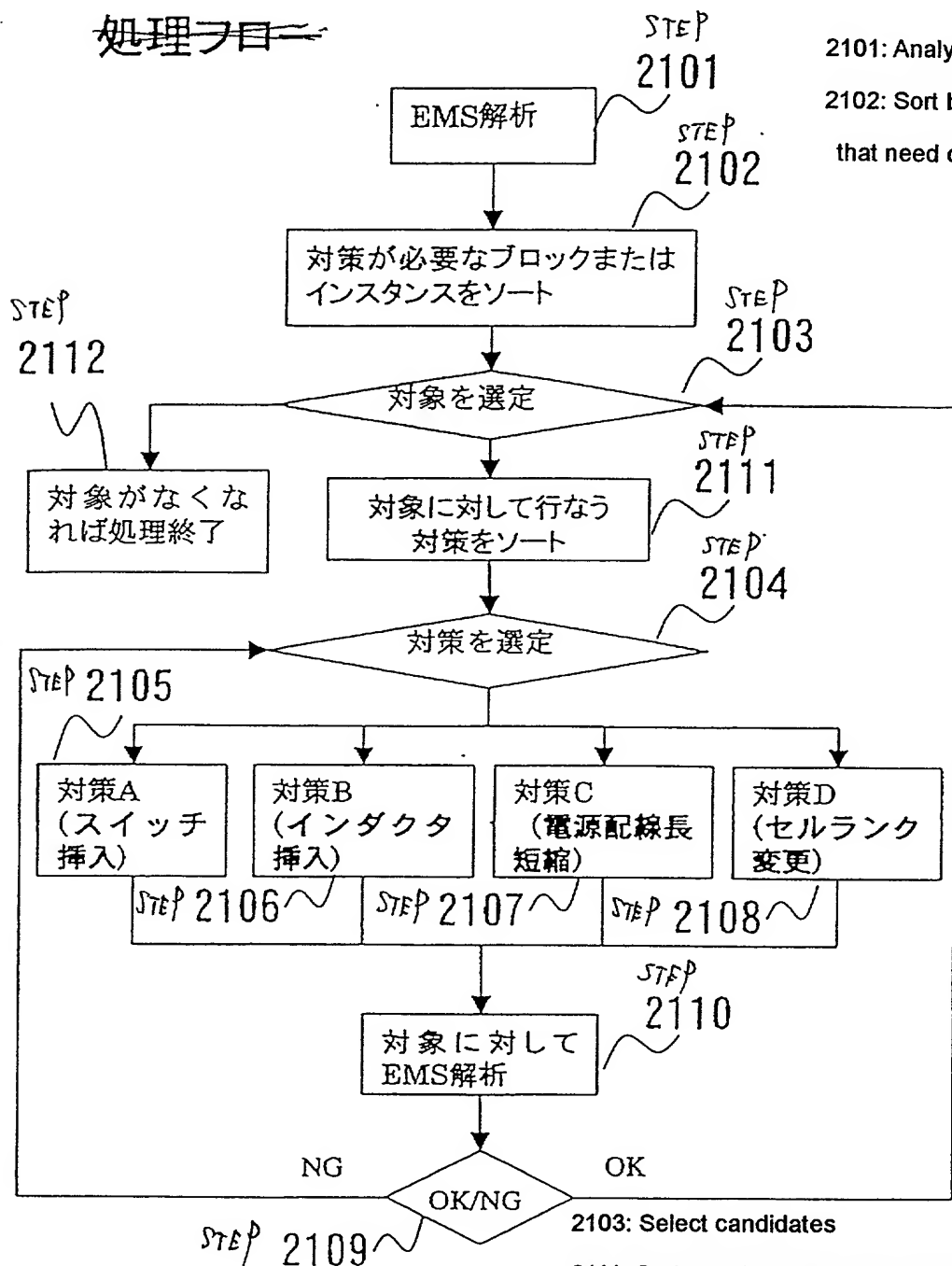
1905: Calculate the possibility of noise waveform calculated from the propagation destination passing through the circuit element at the propagation source based on the library

1906: Propagated?

1907: Calculate the noise waveform at the input assumed when the noise waveform calculated from the propagation destination is propagated through the circuit element at the propagation source based on the library

【図21】 Fig. 21

処理フロー



2101: Analyze EMS

2102: Sort blocks or instances  
that need countermeasures

2103: Select candidates

2111: Sort countermeasures to take

2112: Processing is complete when no candidates are left

2104: Select countermeasure

2105: Countermeasure A (Insert switch)

2106: Countermeasure B (Insert inductor)

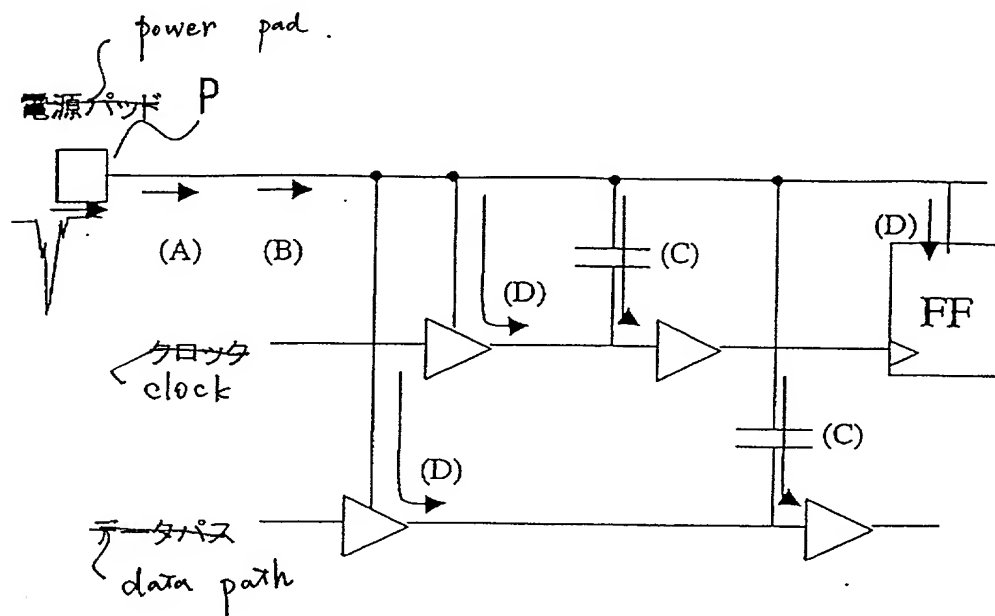
2107: Countermeasure C (Reduce power wiring length)

2108: Countermeasure D (Change cell rank)

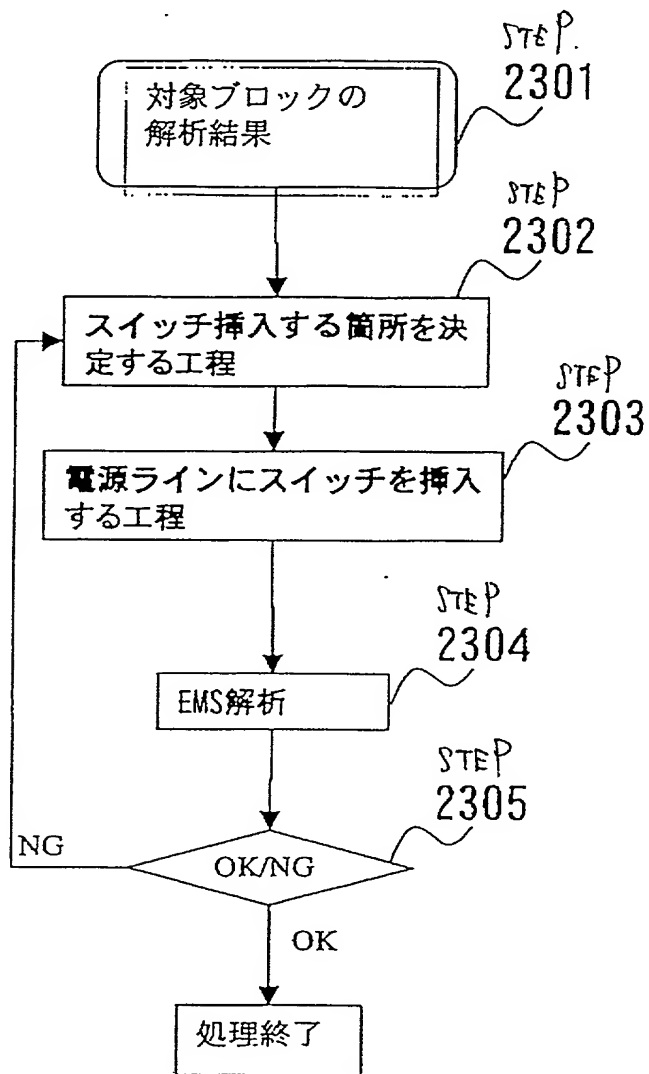
2110: Analyze EMS on candidates

〔図22〕 Fig.22

# ノイズ伝搬経路



[図2-3] Fig. 23

対策A(スイッチ挿入).

2301: Analysis result of candidate block

2302: Step of determining the location where switch is to be inserted.

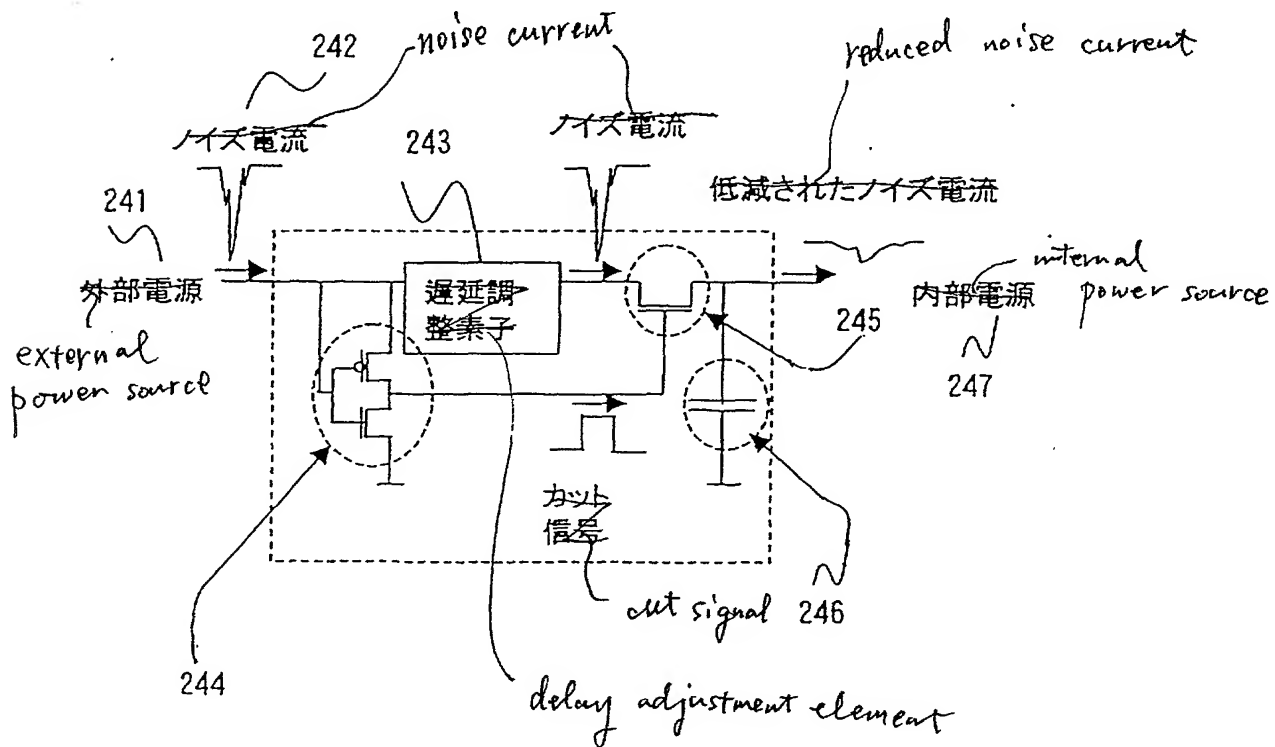
2303: Step of inserting switch in the power line

2304: EMS analysis

Processing complete

[図24] Fig. 24

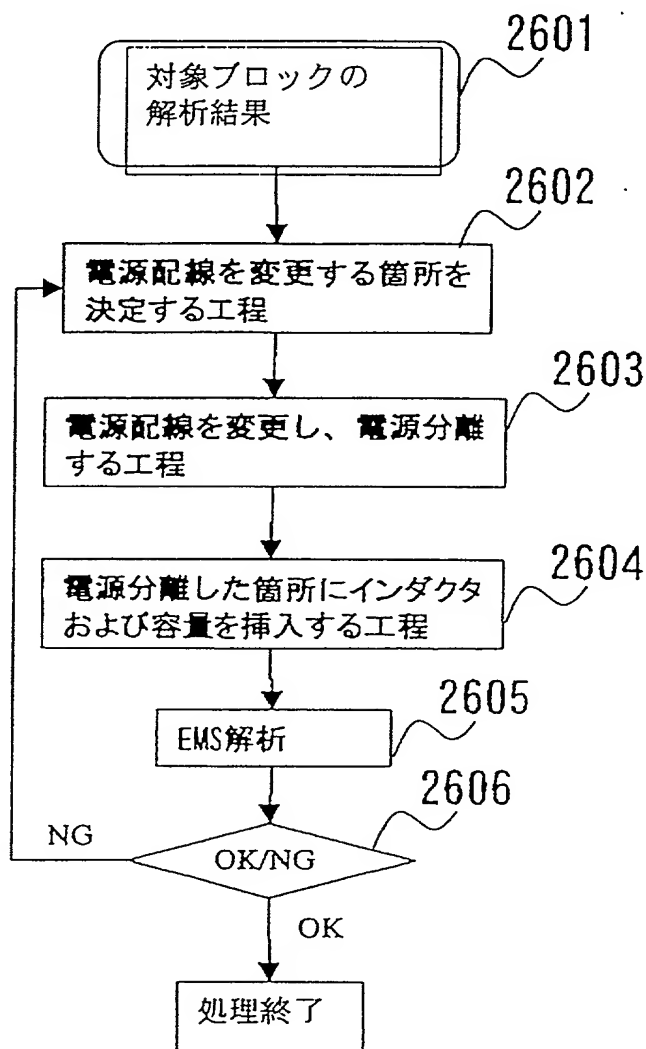
# 対策A(スイッチ回路1)





【図26】 Fig. 26

~~対策B(電源分離→LCフィルタ挿入)~~



2601: Analysis result of candidate block

2602: Step of determining the location where power wiring is to be modified.

2603: Step of modifying power wiring and isolating power source

2604: Step of inserting inductor and capacitance in the location where power is isolated.

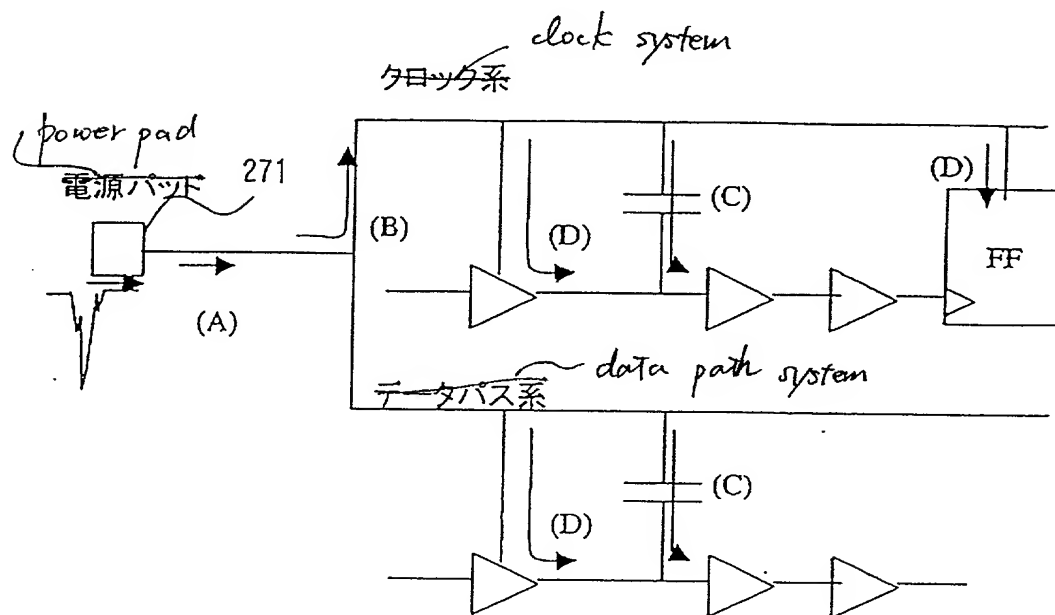
2605: EMS analysis

Processing complete



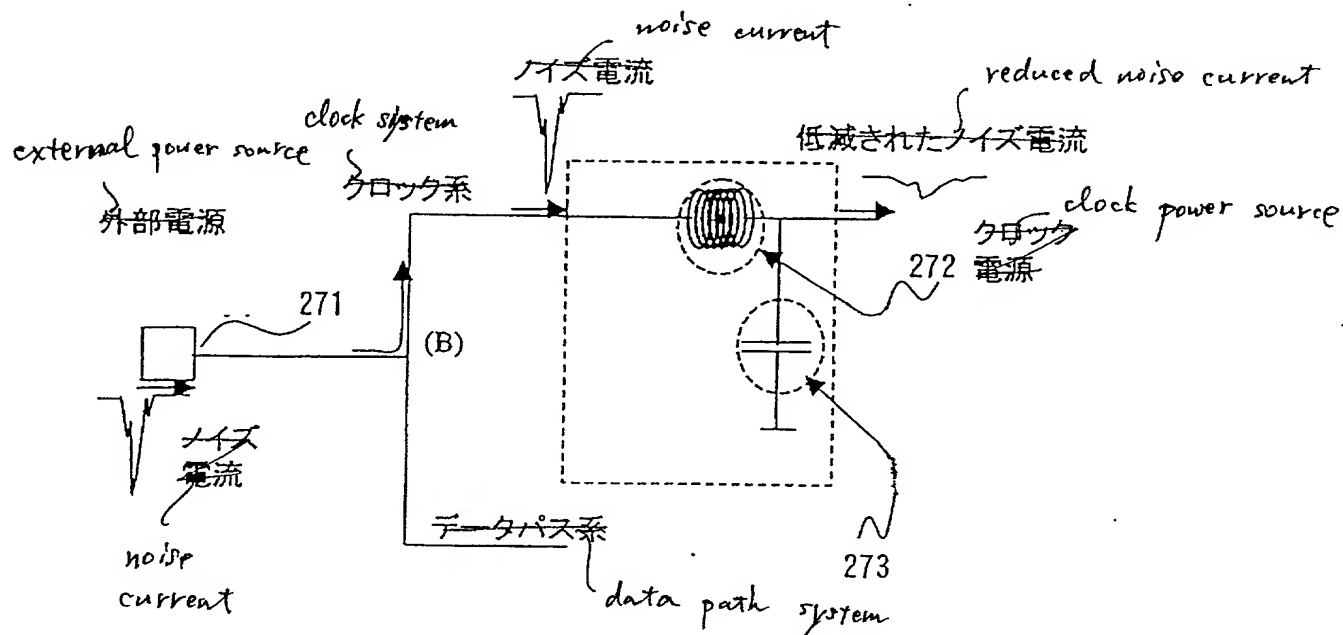
【図27】 Fig. 27

# 対策B(電源分離)

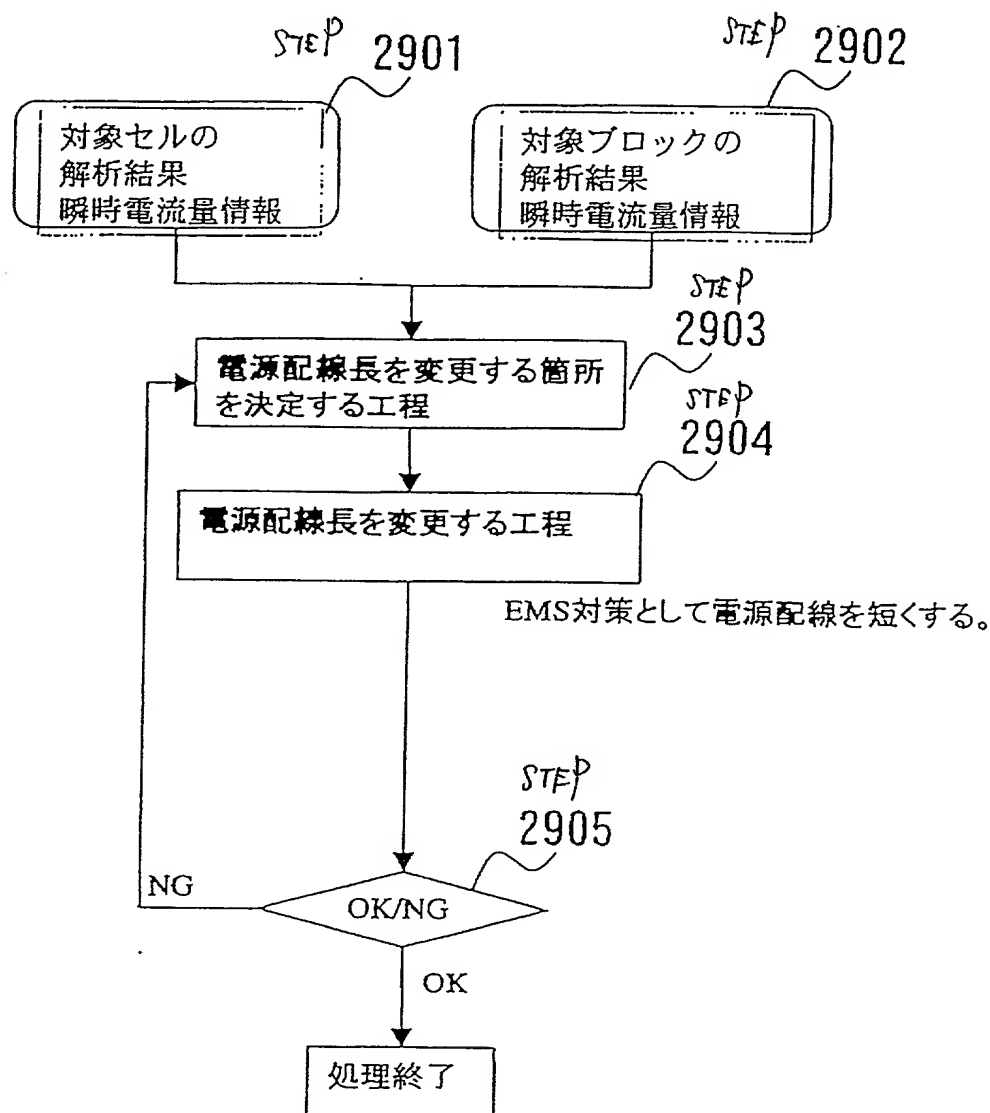


【図2-8】 Fig. 28

# 対策B(LCフィルタ挿入)



【図29】— Fig. 29

対策C(電源配線長短縮)

2901: Analysis result of candidate cell

Instantaneous current amount information

2902: Analysis result of candidate block

Instantaneous current amount information

2903: Step of determining the location where power wiring length is to be changed

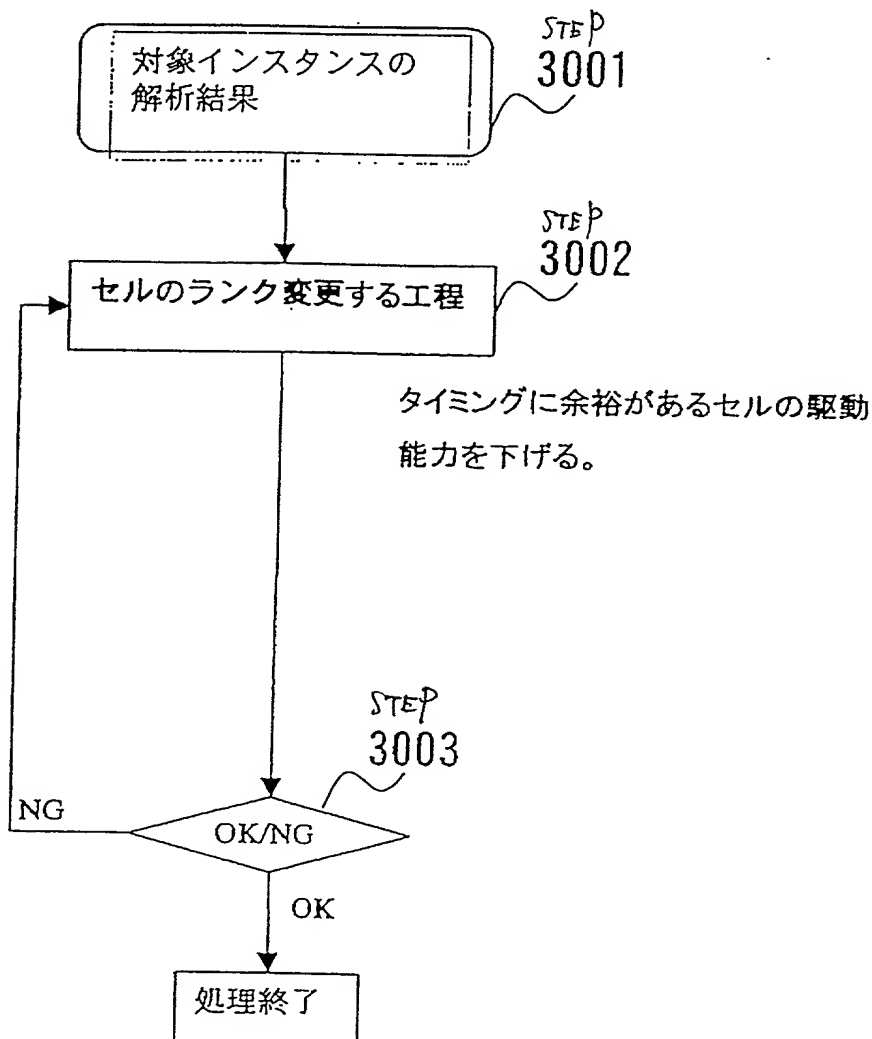
2904: Step of changing power wiring length

Shorten the power wiring as an EMS countermeasure.

Processing complete

【図30】 Fig. 30

# 対策D(セルランク変更)



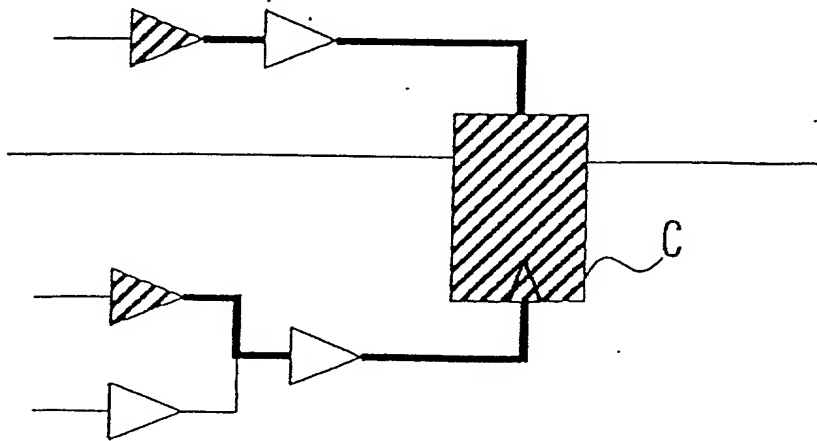
3001: Analysis result of candidate instance

3002: Step of changing rank

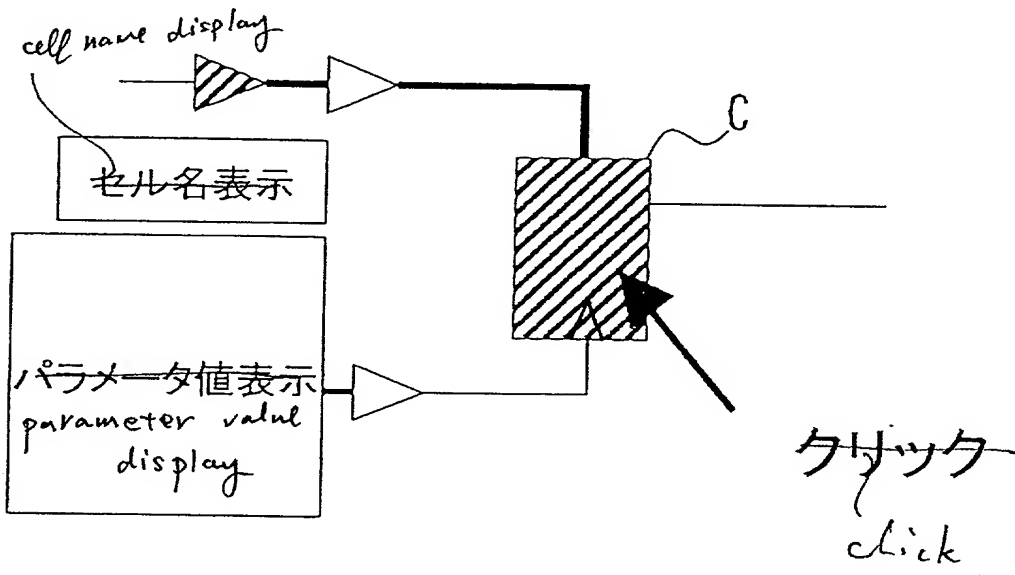
Reduce the drive capability of a cell with sufficient timing.

Processing complete

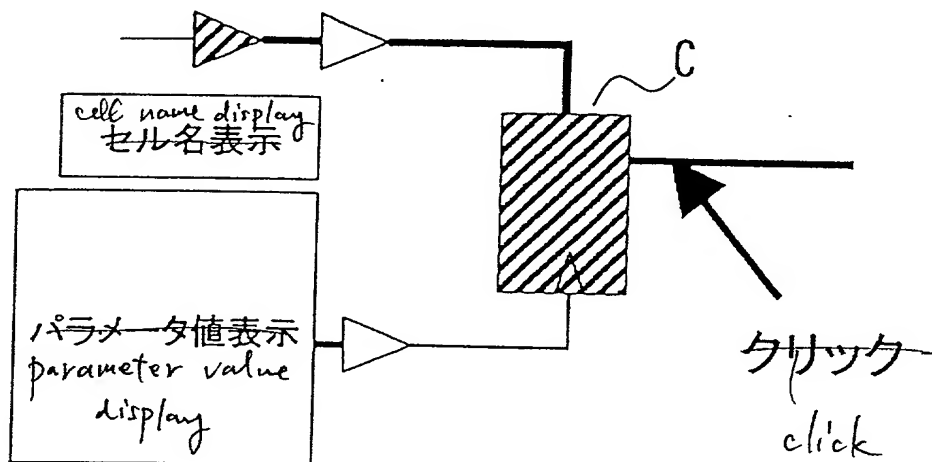
【図31】 Fig.31



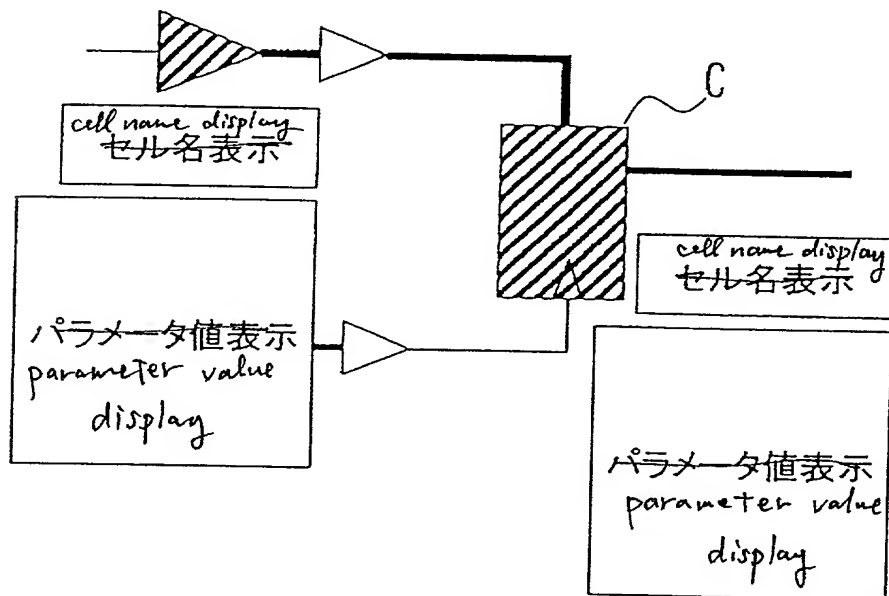
【図32】 Fig.32.



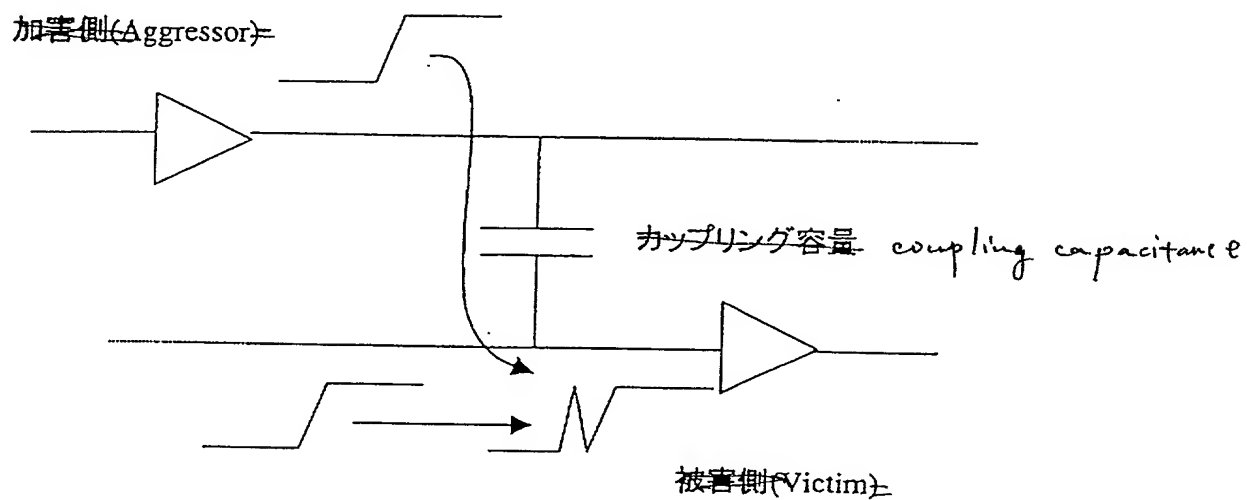
【図3-3】 Fig. 33



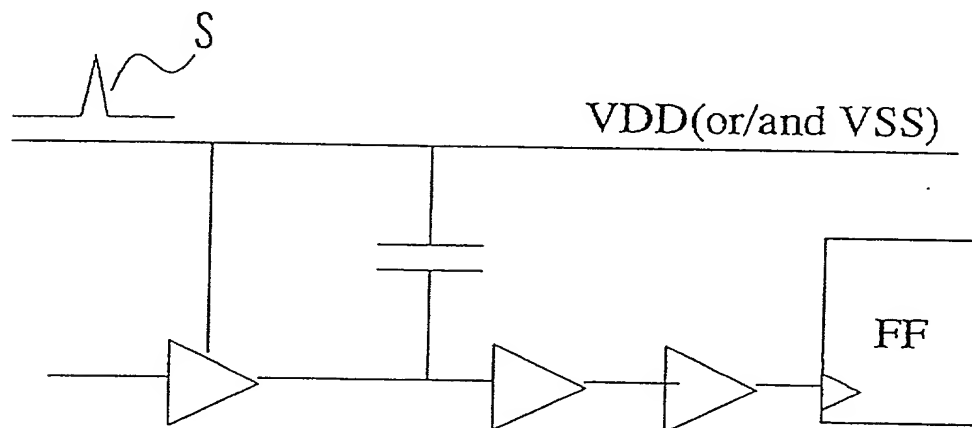
【図3-4】 Fig. 34



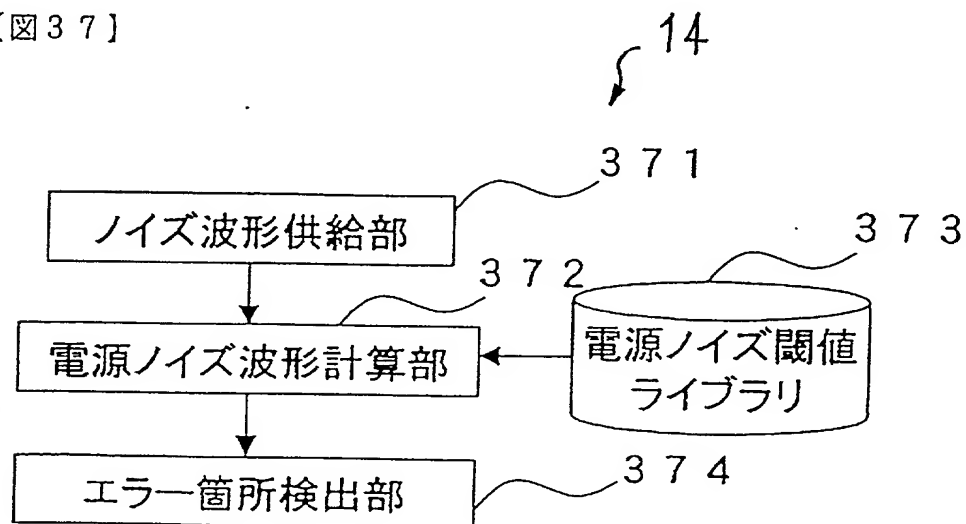
【図35】 Fig. 35



【図36】 Fig. 36



【図37】



371: Noise waveform supply section

372: Power noise waveform calculating section

373: Power noise threshold library

374: Error section detector